

Short Cruise Report

FS METEOR Cruise M67/1

Talcahuano (Chile) – Balboa (Panama)
2006-02-20 – 2006-03-13

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Introduction and Objectives of Cruise M67/1

Cruise M67/1 of RV METEOR was undertaken to gain a better understanding of the relationship between active tectonic processes and fluid venting at convergent continental margins. The role of volatiles and fluids in subduction zones is of great interest as it has major influence on short-term and long-term climate change and on the geochemical evolution of hydrosphere and atmosphere, and it may constitute a major trigger mechanism for natural hazards. The transport of volatiles and fluids through the subduction zone is influenced by tectonic processes, which, again, are modified by fluids and volatiles.

Active tectonic processes dominate the accretionary Chilean continental margin between 33°S and 37°S, particularly on the incoming oceanic plate and the lower and middle continental slope. Tectonic processes shape the morphology of the ocean floor. The morphology can be mapped by bathymetric measurements. The focus of cruise M67/1 was therefore on conducting a detailed bathymetric survey of the continental margin of the area to reveal a high-resolution image of the morphology. In addition, possible venting sites were sampled during the cruise using a gravity corer to reveal indications of active fluid expulsion.

The convergent continental margin of Chile display several various segments with different tectonic characteristics. The northern part is clearly dominated by subduction erosion. The central part around 33°S is controlled by the subduction of the Juan Fernandez Ridge. The area south of 33°S is predominantly accretionary, however, the accretionary prisms are quite small in many areas. Within the CONDOR, SPOC and TIPTEQ projects large areas of the Chilean continental margin have been bathymetrically mapped. This data displays the different segments quite well. Yet, a major part of the margin between 36°S and 33°S has not been mapped before. To survey this area was the main objective of the cruise M67/1.

Bathymetric surveys reveal the morphology of the continental margin and yield information on tectonic processes shaping the morphology. In particular, the following topics are addressed by the mapping survey of M67/1:

- the structure of the oceanic plate before subduction: pattern, size, directions of the horst- and-graben structures created by the bending of the downgoing oceanic lithosphere
- width and sediment infill in the trench
- structure of the central turbidite channel in the trench
- size and structure of the accretionary wedge

- shape and size of the small ridges close to the deformation front
- faults as possible pathways for uprising fluids
- canyons on the upper and middle slope, deposition of terrigenous sediments into the trench
- manifestations of fluid venting on the continental slope
- mass-wasting structures along the margin

Cruise Narrative

METEOR left the pier of the Talcahuano ASMAR shipyard on 21 February for a three-day test cruise. First of all, the new bow thruster and the dynamic positioning system were adjusted, the rest of the time was then dedicated to testing and calibration of the new Kongsberg EM710 and EM120 multibeam echosounders. The EM710 shallow-water system was calibrated and tested in an area north of the Rio Biobio Canyon at water depths of 130 – 230 m. Afterwards, the EM120 deep water system was tested in the mouth of the canyon at a water depth of about 5000 m. After the tests had been completed, METEOR reached the roadstead of Talcahuano bay on 24 February at 10:00. Five technicians and engineers who had been involved in the testing left the vessel. After the ship had been cleared by the Chilean administrative authorities, the transit to the working area started at 11:30.

The scientific programme started with bathymetric and magnetic mapping on 24 February at 3:15 pm. Until March 3, 2006 at 2:30 pm, multibeam bathymetry, PARASOUND echosounding and magnetic recordings were taken along 16 profiles with a total length of 1675 km (see figure 2). Another prominent aim of this leg was to find indications of fluid venting along the continental margin and prepare a geochemical characterization. In total, 10 gravity cores were taken from different sites. The sites were chosen in areas of marked topographic and tectonic structures on the basis of the new, high-resolution bathymetric data and PARASOUND recordings. The most interesting geochemical results can be expected from two cores taken from a small elevation that forms a prolongation of the N-S striking fault line. The upper 50 cm of these cores showed very high H₂S concentrations, which clearly indicate an active ascent of fluids rich in methane. A further, mound-like elevation yielded a sample of authigenic carbonates and cemented shells which also indicate fluid venting. Unfortunately, we did not get a sample of sediments and fluids from this structure.

In order to gain as much time as possible for the investigations in the survey area, the shortest possible route had been chosen for the 11-day transit to Panama. During the transit no considerable scientific data acquisition was done, apart from occasional operation of the multibeam and PARASOUND systems in international waters for several tests. The transit time was used for analyzing and archiving the samples of the gravity cores and for processing of the multibeam bathymetry data. The equator was passed on Saturday March 11 early in the morning. Due to favourable weather conditions the anchorage at Balboa was reached in time on Monday March 13 at noon.

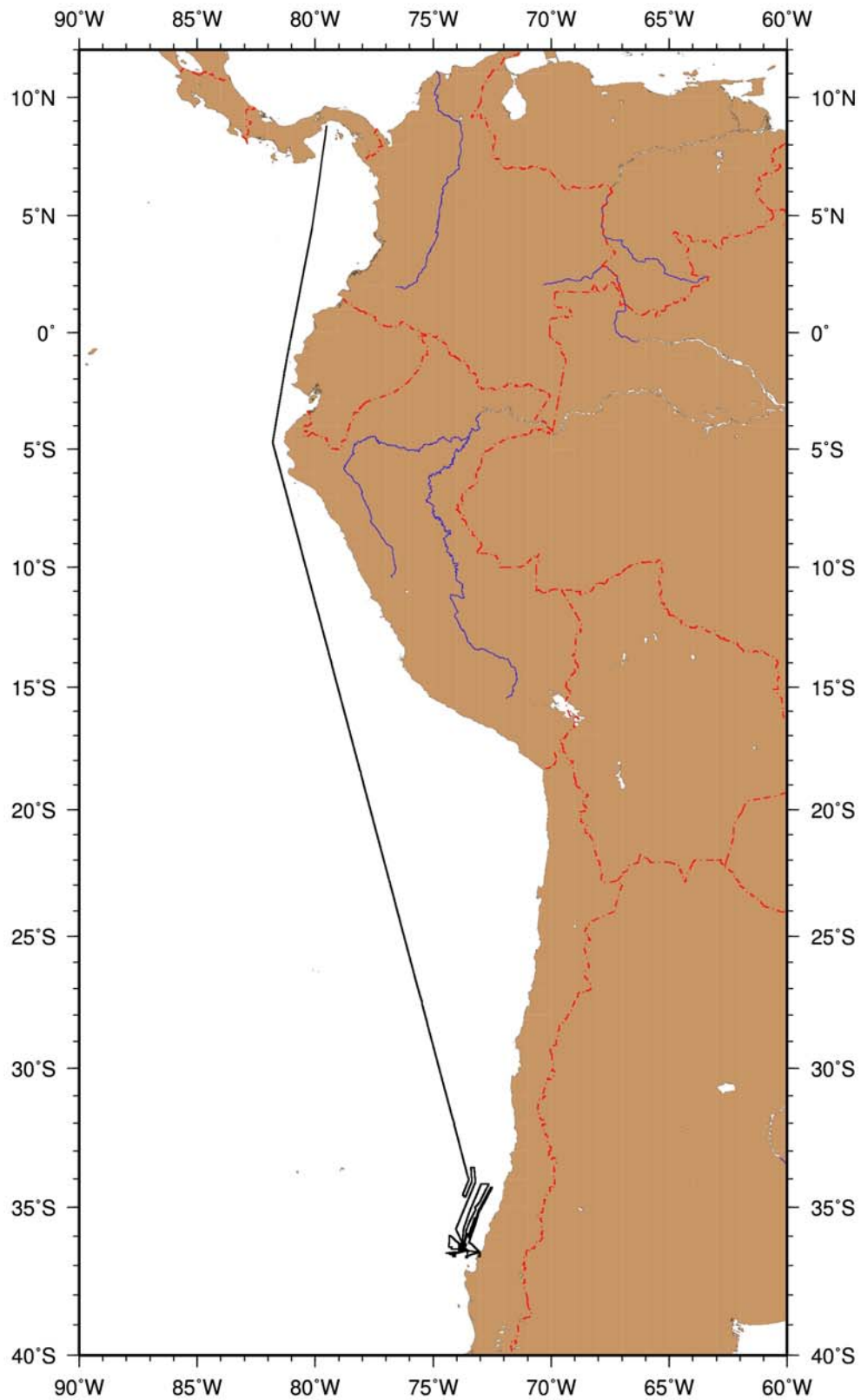


Figure 1: Total track of the cruise METEOR M67/1 from Talcahuano (Chile) to Balboa (Panama)

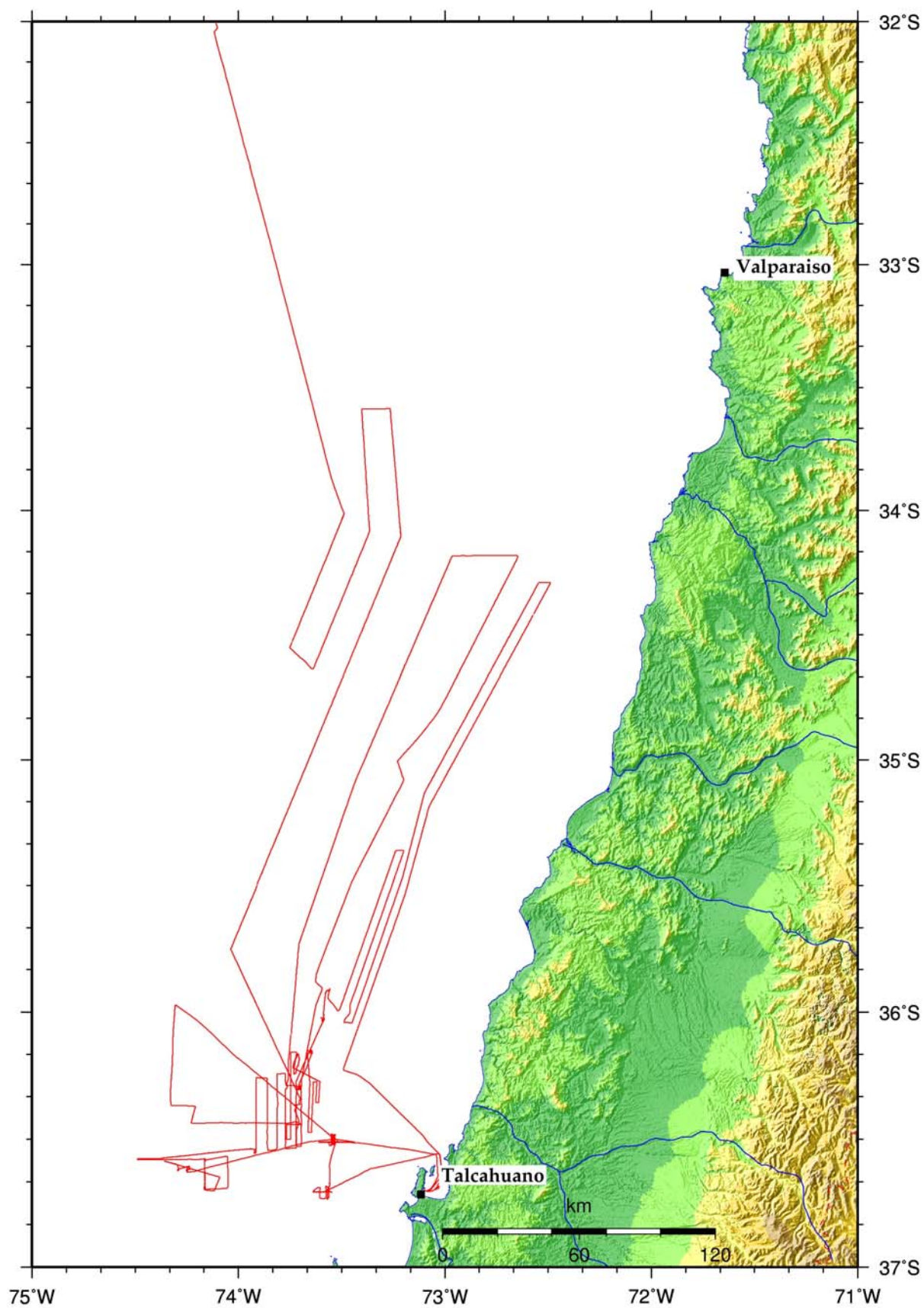


Figure 2: Cruise track of METEOR M67/1 in the main working area